REMARKS

Claims 1-16 are all the claims presently pending in the application. Claims 1, 6-8, 14 and 16 have been amended to more particularly define the invention. Claims 17-20 have been added to assure Applicant the degree of protection to which his invention entitles him.

It is noted that the claim amendments herein or later are not made to distinguish the invention over the prior art or narrow the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein or later should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

With respect to the prior art rejections, claims 1, 4-5, 7, and 10-13 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Slater, et al. (U.S. Patent No. 6,791,119). Claims 2-3 and 14-16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Slater in view of Lin et al. (U.S. Patent No. 6,614,058). Claims 6 and 8-9 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Slater in view of Lowery, et al. (U.S. Patent No. 6,351,069).

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

An exemplary aspect of the invention, as recited in claim 1, is directed to a light emitting apparatus including a semiconductor light emitting element including a substrate, wherein light radiates from a light emission surface of the substrate of the light emitting element, the light emission surface being provided on the substrate opposite to an electrode

forming surface of the substrate, and a transparent structure mounted on the light emission surface of the substrate, wherein the transparent structure is optically connected with the light emission surface and has a light distribution characteristic based on a three-dimensional shape of the transparent structure.

Another aspect of the present invention, as recited in claim 8, provides a light emitting apparatus including a semiconductor light emitting element that includes a substrate and that radiates light from a light emission surface provided on the substrate of the semiconductor light emitting element opposite an electrode forming surface of the substrate, lead frames that are electrically connected to electrodes formed on the electrode forming surface through wires, a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface and has a light distribution characteristic based on a three-dimensional shape of the transparent structure; and light transmitting resin that seals the semiconductor light emitting element and the transparent structure, the light transmitting resin including a phosphor to wavelength-convert light emitted from the semiconductor light emitting element.

A further aspect of the invention, as recited in claim 16, is directed to a light emitting apparatus including a semiconductor light emitting element that includes a substrate and that radiates light from a light emission surface provided on the substrate of the semiconductor light emitting element opposite to an electrode forming surface of the substrate, lead frames that are electrically connected to electrodes formed on the electrode forming surface through wires, a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface and has a light distribution

characteristic based on a three-dimensional shape of the transparent structure, and light transmitting resin that seals the semiconductor light emitting element and the transparent structure. The transparent structure has a length in the horizontal direction greater than that of the semiconductor light emitting element.

A conventional light emitting apparatus includes an LED chip housed in a concave portion of a package, a first and second coating of light transmitting resin embedding in the concave portion and bonding wires connecting the LED chip to external electrodes. The second resin coating may contain a phosphor for wavelength-converting light passing therethrough. (See Application at page 1, lines 20-29 and Figure 1)

However, the phosphor in the second layer and electrodes on the LED chip can block the radiation of light, thus lowering the light extraction efficiency of the apparatus and resulting in insufficient brightness. (See Application at Figure 1 and page 3, lines 18-24) Further, the manufacture of such apparatuses can be complicated and expensive. (See Application at page 3, lines 9-15 and lines 25-29, and page 4, lines 1-2)

The claimed invention, on the other hand, includes a semiconductor light emitting element that radiates light from a light emission surface provided on a substrate of the light emitting element opposite an electrode forming surface of the substrate and a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface and has a light distribution characteristic based on its three-dimensional shape. These features, amongst others, provide a light emitting apparatus which has high light extraction efficiency while utilizing the easy to manufacture wire-bonding structure.

II. THE PRIOR ART REFERENCES

A. The Slater et al. Reference

The Examiner alleges that the invention of claims 1, 4-5, 7 and 10-13 are anticipated by Slater et al. However, Applicant respectfully submits that the reference does not teach or suggest each and every element of the claimed invention.

Slater et al. discloses a light emitting diode including a substrate having first and second opposing faces and that is transparent to optical radiation in a predetermined wavelength range and that is patterned to define, in cross-section, a plurality of pedestals that extend into the substrate from the first face toward the second face. (Slater et al. at Abstract)

However, Slater et al. does not disclose or suggest "*a transparent structure mounted on the light emission surface of the substrate, wherein the transparent structure is optically connected with the light emission surface and has a light distribution characteristic based on a three-dimensional shape of the transparent structure*," as recited in claims 1, 4-5, 7 and 10-13. (Emphasis added)

Instead, Slater et al. discloses a light emitting diode 100 including a silicon carbide substrate 110 having first and second opposing faces 110a, 110b. A diode region 170 is formed on the second face 110b of the substrate 110 and is configured to emit light into the substrate 110 upon application of a voltage. (See Slater et al. at Figure 1 and column 7, lines 20-31) In Slater et al., similar to conventional devices, light generated by the diode 100 is emitted into the substrate 110 for extraction.

Slater et al. discloses that the light emitting diode 200 can be used in a flip-chip configuration, wherein the light emitting diode 200 is mounted upside down on a mounting

substrate 210, such as a heat sink. (See Slater et al. at Figures 2 and 3, and column 10, lines 15-20) The flip-configuration places the substrate 110 up, away from the mounting substrate 210, and places the diode region 170 down, adjacent to the mounting substrate 210. (See Slater et al. at Figures 2 and 3, and column 10, lines 26-30) In this manner, light generated in the diode region 170 only needs to travel through the substrate 110 to exit the device. (See Slater et al. at column 11, lines 1-3)

Slater et al. further teaches geometric modifications of the <u>substrate 710</u> (e.g. 110) that provide a "means for extracting, from the <u>substrate</u>, at least some of the light, and allow enhanced extraction efficiency from interior regions of the <u>substrate</u>." (Slater et al. at column 12, lines 30-34) (Emphasis added) In particular, Slater et al. discloses that <u>the first face 710a of the substrate 710 includes therein a plurality of grooves 720 that define the pedestals 730 in the substrate 710</u>. The diode region 740 (e.g. 170) is on the second face 710b of the substrate 710. (See Slater et al. at Figures 7A and 7B, and column 12, lines 45-55)

However, the Examiner alleges that the pedestals 730 of Slater et al. teach the transparent structure of the claimed invention. In an apparent attempted (albeit confusing and improper) "mixing" of independent embodiments of Slater et al., the Examiner further alleges that the pedestals 730 disclosed in Slater et al. are mounted on the mounting substrate 210 of Slater et al.

The present invention, though, provides a <u>transparent structure that is bonded to the light emission surface of the substrate of a LED chip</u>. As such, the <u>transparent structure</u> is a separate and distinct element that is <u>mounted on the light emission surface of the substrate</u>

opposite the electrode forming surface of the substrate. As exemplarily shown in Figure 4, the transparent structure 5 is mounted on the sapphire substrate 3A of an LED chip 3 by an adhesive layer 4. (See Application at Figure 4, page 7, lines 12-19)

In Slater et al., as noted above, the pedestals 730 are defined by grooves 720 in the first face 710a of the substrate 710 and, thus, are an integral feature of the substrate 710. Therefore, the pedestals 730 disclosed in Slater et al. clearly are not a separate structure and there is no disclosure or suggestion in Slater et al. that they may be mounted on the first face 710a of the substrate 710 opposite the second face 710b of the substrate upon which the diode 740 is formed. Clearly, Slater et al. does not teach or suggest the transparent structure of the claimed invention.

Further, contrary to the allegations of the Examiner, Slater et al. does not teach or suggest that the pedestals 730 may be mounted on the mounting substrate 210. As noted above, Slater et al. clearly discloses that the substrate 110 is located up, away from the mounting substrate 210, while the diode region 170 is down, adjacent to the mounting substrate 210. In this manner, light generated in the diode region 170 of Slater et al. simply needs to travel through the substrate 110 to exit the device. There is no indication or suggestion in Slater et al. that light is extracted by the mounting device 210. Indeed, there is no teaching or disclosure in Slater et al. that the mounting substrate 210 includes a light emission surface of any sort or that the pedestals 730 could be mounted thereon. Clearly, Slater et al. does not teach or suggest a transparent structure that is mounted on the light emission surface of the substrate, as in the claimed invention.

In the claimed invention, by extracting light through the transparent structure, the light emission density may be lowered and a light distribution characteristic different from that of the LED chip by itself can be obtained. Additionally, since the light emission area is enlarged due to the transparent structure, the light shield effect caused by covering the LED with a phosphor can be reduced and, thereby, the brightness can be enhanced. (See Application at page 10, lines 19-29)

Moreover, by mounting the transparent structure on the substrate, as in the claimed invention, the LED chip can easily be connected to the lead frames through the bonding wires during manufacture. Also, the manufacturing process can be simplified since the transparent structure renders the accurate positioning required to produce conventional devices unnecessary. (See Application at page 10, lines 10-18)

Indeed, Slater et al. makes no reference or suggestion to "*a transparent structure mounted on the light emission surface of the substrate, wherein the transparent structure is optically connected with the light emission surface and has a light distribution characteristic based on a three-dimensional shape of the transparent structure*," as recited in claims 1, 4-5, 7 and 10-13. (Emphasis added). In fact, Slater et al. fails to even recognize the desirability or benefits of providing such a transparent structure. Rather, Slater et al. merely modifies the geometry of the substrate of the LED chip in order to enhance extraction efficiency from interior regions of the substrate.

Therefore, Applicant submits that there are elements of the invention of claims 1, 4-5, 7 and 10-13 that are not taught or suggested by Slater et al. Therefore, the Examiner is respectfully requested to withdraw this rejection.

B. The Lin et al. Reference

The Examiner alleges that Slater et al. would have been combined with Lin et al. to form the invention of claims 2-3 and 14-16. However, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Lin et al. discloses a light emitting semiconductor device with a surface-mounted and flip-chip package structure. (Lin et al. at Abstract)

Applicant respectfully submits that these references would not have been combined as alleged by the Examiner. Indeed, no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

In fact, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, contrary to the Examiner's allegations, none of these references teaches or suggests their combination.

Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

The Examiner concedes that Slater et al. fails to disclose or suggest that "the transparent structure has a length in the horizontal direction greater than that of the semiconductor light emitting element," as recited in claims 2 and 16. Rather, the Examiner attempts to rely on Figure 5, column 5, lines 59-67, and column 3, lines 38-40 of Lin et al. to make up for the deficiencies of Slater et al.

However, this feature is not taught or suggested by Lin et al. In fact, nowhere do the cited figure or passages teach or suggest that the transparent structure has a length in the horizontal direction greater than that of the semiconductor light emitting element in order to enlarge the light emission area and enhance the brightness of the apparatus.

Rather, Lin et al. discloses that "the sidewall of the LED 402 can be on an incline 430." (See Lin et al. at column 5, lines 59-60) Lin et al. further discloses that "the light emitted from the LED 402 can radiate outwardly by transmitting through the sapphire substrate 403." (See Lin et al. at column 5, lines 63-67) Thus, Lin et al. merely discloses that the substrate 403 may have an inclined surface.

Therefore, similar to Slater et al., Lin et al. merely modifies the substrate of the LED. Indeed, Lin et al. makes no reference or suggestion to a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface, and certainly not to the transparent structure having a length in the horizontal direction greater than that of the semiconductor light emitting element, as required in claims 2 and 16. Clearly, Lin et al. fails to make up for the deficiencies of Slater et al.

Indeed, Lin et al. fails to make up for the deficiencies of Slater et al. described above, directed to a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface of the substrate in order to provide a light emitting apparatus which has high light extraction and ease of manufacture.

Therefore, even assuming arguendo that Lin et al. may disclose that the substrate may have a length in the horizontal direction greater than that of the semiconductor light emitting

element, as alleged by the Examiner, there is no teaching or suggestion in Lin et al. of a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface to provide a light emitting apparatus which has high light extraction and ease of manufacture, as in claims 2-3 and 14-16. Indeed, the cited reference does not even recognize the desirability or benefit of providing such a feature. Therefore, Lin et al. clearly does not make up for the deficiencies of Slater et al.

Further, with regard to claims 14 and 15, the Examiner concedes that Slater et al. fails to teach or suggest an adhesive to connect the transparent structure to the light emitting surface and attempts to rely on Lin et al. to make up for the deficiencies of Slater et al.

However, as previously shown, neither reference teaches or suggests the transparent structure of the claimed invention. In fact, the pedestals 730 disclosed in Slater et al., alleged by the Examiner to teach the transparent structure, are an integral feature of the substrate 710 formed in the first face 710a of the substrate, as noted above. Clearly, the pedestals of Slater et al. would not be attached to the substrate by an adhesive or otherwise, since the pedestals are not a separate structure mounted on the substrate. Thus, Applicant respectfully submits that the Examiner's proposed combination regarding claims 14 and 15 is improper.

In light of the above, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the invention of claims 2-3 and 14-16. Therefore, the Examiner is respectfully requested to withdraw this rejection.

C. The Lowery et al. Reference

The Examiner alleges that Slater et al. would have been combined with Lowery et al. to form the invention of claims 6 and 8-9. However, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Lowery et al. discloses a light emitting device and a method of fabricating the device utilizing a supplementary fluorescent material that radiates secondary light in the red spectral region of the visible light spectrum to increase the red color component of the composite output light. (Lowery et al. at Abstract)

Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, contrary to the Examiner's allegations, none of these references teaches or suggests their combination.

Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Further, Lowery et al. fails to make up for the deficiencies of Slater et al. described above, directed toward a transparent structure that is mounted on the light emission surface of the substrate and optically connected with the light emission surface and has a light distribution characteristic to provide a light emitting apparatus which has high light extraction and ease of manufacture.

The Examiner concedes that Slater et al. fails to disclose or suggest that "one of the lead frames has a cup portion, and the transparent structure is fixed on the cup portion

through adhesive resin," as recited in claim 6. Rather, the Examiner attempts to rely on Figure 3 of Lowery et al. to make up for the deficiencies of Slater et al.

However, these features are not taught or suggested by Lowery et al. In fact, nowhere do the cited figure or passages teach or suggest that the transparent structure is adhered to the cup portion of the lead frame.

Rather, Lowery et al. discloses that a "light emitting device is an LED that includes a die that emits primary light in response to an electrical signal," and that "the die is a Gallium Nitride (GaN) based die." (Lowery et al. at column 2, lines 50-52) Lowery et al. further discloses that it is "the Gallium Nitride (GaN) die 12 that is positioned on the reflector cup lead frame." (Lowery et al. at column 4, lines 61-63) (Emphasis added) Thus, Lowery et al. merely discloses that the Gallium Nitride (GaN) die 12 is attached to the lead frame.

Indeed, Lowery et al. makes no reference or suggestion to a transparent structure that is mounted on the substrate and optically connected with the light emission surface on the substrate, and certainly not to the transparent structure being adhered to the cup portion of the lead frame, as required in claim 6. Clearly, Lowery et al. fails to make up for the deficiencies of Slater et al.

The Examiner further asserts that Slater et al. would have been modified by Lowery et al. to teach "the light transmitting resin including a phosphor to wavelength-convert light emitted from the semiconductor light emitting element," as recited in claim 8, and also that "the light transmitting resin contains two or more kinds of phosphors," as recited in claim 9.

However, as noted above, Lowery et al. makes no reference or suggestion to a transparent structure that is mounted on the substrate and optically connected with the light

emission surface, as required in claims 8 and 9.

Thus, even assuming arguendo that Lowery et al. may disclose that the light transmitting resin may include one or more phosphors, as alleged by the Examiner, there is no teaching or suggestion in Lowery et al. of a transparent structure that is mounted on light emission surface of the substrate and optically connected with the light emission surface to provide a light emitting apparatus which has high light extraction and ease of manufacture, as in claims 6 and 8-9. Indeed, the cited reference does not even recognize the desirability or benefit of providing such a feature. Therefore, Lowery et al. clearly does not make up for the deficiencies of Slater et al.

In light of the above, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. CONCLUSION

In view of the foregoing, Applicant submits that claims 1-20, all the claims presently pending in the application, are patentably distinct over the prior art of record and are allowable, and that the application is in condition for allowance. Such action would be appreciated.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned attorney at the local telephone number

listed below to discuss any other changes deemed necessary for allowance in a telephonic or personal interview.

To the extent necessary, Applicant petitions for an extension of time under 37 CFR §1.136. The Commissioner is authorized to charge any deficiency in fees, including extension of time fees, or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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